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ABSTRACT

Until 1982, achievement in A-level biology in Kenya was measured by an examination which consisted of four papers, three measuring theory work and one measuring practical skills. In 1982, a three paper examination was developed, the first two papers measuring theory and the third paper measuring practical skills. Based on the change in the test format (and also on the concern for the Kenya National Examination Council's great emphasis on the practical examination in determining the overall grade of candidates), this study: (1) determined the degree of correlation between biology papers I and II, between biology papers I and III, and between biology papers I, II, and III for all schools, national schools, non-national schools, girls' schools, and boys' schools in 1982; (2) repeated the above correlations for 1981 biology papers I, II, III, and IV; and (3) investigated some of the reasons and causes for the correlations obtained. Results indicate low correlation coefficients between the theory papers and between theory and practical papers for both 1981 and 1982. In addition, lack of coverage of the A-level biology syllabus was found to be a major factor contributing to the low correlations. Recommendations based on these and other findings are included. (JN)

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RELATIONSHIP BETWEEN THEORY AND PRACTICAL BIOLOGY AT 'A' LEVEL IN KENYAN SECONDARY SCHOOLS.

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This research project was undertaken as part of a training programme jointly organised on behalf of the African Curriculum Organisation (ACO) by the Kenya Institute of Education (KIE), the University of Nairobi, and the German Agency for Technical Cooperation (GTZ).

AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN THEORY AND PRACTICAL BIOLOGY AT 'A' LEVEL IN KENYAN SECONDARY SCHOOLs.

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CHAPTER I

BACKGROUND TO THE STUDY

1.1 Introduction

In East Africa and Malaysia, the Cambridge University, Schools' Examination Syndicate for Overseas centres was in operation up to 1968-1970. In 1967 the East African Examination Council was set up under the auspices of the East African Community. The members of the community were Kenya, Uganda and Tanzania. The Council worked together with the Cambridge syndicate until 1973 and then took over complete control of the examination in 1974. In 1980, The East African Community was dissolved and the Kenya National Examinations Council was set up as the national examining body for Kenya. The Kenya National Examinations Council (K.N.E.C) is under the Ministry of Higher Education. The Ministry lays emphasis on a number of general aims in the teaching of biology to 'A' level students. In particular the syllabus stresses the importance of integrating theory and practical work by carrying out simple experiments and demonstrations while teaching the theory. This encourages a style of teaching whereby simple experimental work and theory are interwoven in each lesson for effective understanding of the underlying principles. In this way the syllabus discourages excessive memorisation and factual

recall and encourages understanding of the basis and nature of observed biological behaviour. Such an understanding is demonstrated by the students ability to:-

(a) draw valid conclusions by analysing and interpreting the observations and results of experiments.

(b) translate information from one form to another.

(c) determine the most valid biological laws that need to be applied to solve some biological problems.

(d) show originality and imagination in choosing the most suitable design for a particular experiment.

(e) decide on what variables need to be controlled and how they should be controlled, when doing experiments.

(f) make accurate experimental observations and record results in the most appropriate way that enable them to draw maximum information from the data and clearly see any trends between variables.

(g) obtain and utilize the relevant biological information concerning the world around them, and understand how such information is applied in a local setting.

The skills and abilities outlined above are relevant for students who intend to continue with the study of biology as well as for terminal

students who have to apply what they have learnt in dealing with the outside world. The 'A' level examination attempts to determine the extent to which these skills and abilities have been achieved. For a practical subject such as biology, the 'A' level student is expected to attain certain practical skills.

In the past years 'A' level biology, unlike the other science subjects such as physics and chemistry, consisted of four papers. Paper I, II and III tested the theory work whereas Paper IV tested the practical skills. However, in 1982 the Kenya National Examination Council decided to combine Papers I and II into one paper without changing the style or the standard of the questions. The combined papers now form Paper I, the original paper III is now paper II and the original paper IV is paper III which is a practical. The decision to reduce the number of the biology examination papers from four to three was an attempt for the Council to keep in line with the other science subjects whereby candidates sit for three papers.

Hence the 1982 'A' level biology examination consisted of the following papers:-

Paper I ---------- 2½ hrs

Paper II ---------- 2½ hrs

Paper III ---------- 3 hrs.

<u>Paper I:</u> Section A of this paper consists of

items of multiple choice objective type, all of which are to be attempted by the candidates (see appendix). Section B consists of compulsory structured questions with several sub-parts.

Paper II:

Section A consists of two compulsory essay type questions which are general in nature. Candidates are to attempt the two questions in section A and any two others in section B (see appendix). Since the questions in section B have similar degree of difficulty and are further testing similar type of skills, the differences in choice of questions by different students does not put any candidate at a disadvantage.

Paper III:

This is a practical paper (see appendix) consisting of three questions. The first question deals with the dissection of a small animal. Out of the seven objectives for the 'A' level biology course listed on page two (2) the questions in paper III seem to predominantly test the abilities and skills related to the first, second and sixth objectives.

Any section of the syllabus may be examined in any of the three papers. Every attempt is made to test the major topics of the syllabus. The questions set are supposed to test achievement of the stated objectives of the biology course. Very little emphasis is placed on testing for mere recall

of factual information.

The Kenya National Examination Council Research Unit analyses the students' performance every year. This is undertaken in areas where the Council has personnel. The purpose for this is to bring to light areas of general weaknesses in the students' work to which teachers and curriculum developers are to pay particular attention. Owing to lack of personnel, the K.N.E.C. research section has not been able to do similar analysis for the biology examinations over the past years. Also the 'A' level biology syllabus has not been evaluated since 1978 after being tried in schools for three years.

Complaint letters from teachers in the field have been received by the biology curriculum developer at the Kenya Institute of Education seeking advice on various aspects of the 'A' level biology course - particularly on the ecology section. Teachers have complained that the examiner demands much more than an average form six candidate can master in two years. Some have also complained that the syllabus is too long to cover in the short time available. Many teachers have asked the question "At what level does the examiner really want the candidates to answer the questions on ecology?" Part of the problem is that a large number of the 'A' level biology teachers have had no inservice training on the new syllabus and so they tend to teach the various topics in the old traditional fashion

following the same lines in which they themselves were taught.

Reference books for teachers in schools are few. Teaching aids and apparatus for practical work are also few. However, the 'A' level biology Teacher's Guide is based largely on the available materials and equipment common to the majority of schools in Kenya. The time to be spent on demonstration work has been kept to a minimum as is included only when equipment, material or time may be limiting factors. The present Teacher's Guide forms a companion to the textbooks on biology. It presents an analysis of the subject matter in suitable units or topics and helps the teacher in actual teaching in the classroom. It includes a list of aims for each topic as an expansion of the main syllabus. This gives details of all important teaching points. It also gives an idea of the method of teaching. The demonstrations and experiments to be performed to build up the right concepts have also been explained. Review, evaluation questions and references have also been suggested for the teacher. Teachers, however, need not follow the guide rigidly but it is hoped that with its help the teacher will be able to evolve a method of teaching of his/her own which will be most effective and fruitful.

Unfortunately biology examiners' reports over the years have shown that some teachers, partly,

from customary attitudes to authority, and partly from lack of confidence do not like to deviate from what is suggested in the Teacher's Guide. Some teachers have failed to appreciate the fact that the Teacher's Guide is not meant to limit their laboratory experiences. Infact the Teacher's Guide should be regarded strictly as a guide and that where it stops the teacher should "pick up the ball."

1.2 Grading of Secondary Schools in Kenya

Secondary schools in Kenya are graded. The purpose for grading a school is to indicate its academic and physical development. All secondary schools which are fully registered are graded as A, B, C and D. Schools may progress to higher grade (C, B or A) following inspections which lead to the approval by the Chief Inspector of schools of upgrading recommendations. It is also possible for an inspection to lead to a recommendation for the demotion of a school. The demotion of a school is an indication of a serious deterioration in the standards and facilities in the school.

Grade A School Requirements:

All national schools are in this category. Grade A schools have the following:-

(1) A well balanced and organised curriculum including academic and non-academic subjects in a full-time secondary course.

(2) An adequate and well qualified staff of whom

a substantial portion are university graduates.

(3) A high standard of teaching and of syllabus planning.

(4) A suitable provision of equipment for all subjects and particularly for those of a practical nature.

(5) An adequate provision of suitable text books.

(6) A well equipped school library.

(7) Equipment and premises of an approved standard for teaching of sciences; and also of an approved standard of Agriculture, Health Science, Industrial Education, Commercial subjects according to which of these practical subjects may be included.

(8) Buildings, school site and playing fields of a good standard.

(9) Properly maintained school records, including those of finance.

Grade B School Requirements:

All government aided 'A' level non-national schools fall in this category. Secondary schools graded B fall short of the high standard of staff, facilities, organisation and equipment possessed by schools awarded an A grade. They have, however, reached a reasonable standard academically and possess the resources for all round development in future.

Grade C School Requirements:

Secondary schools in this category possess clear academic and physical deficiencies but have

a definite potential for the future.

Grade D School Requirements:

Any secondary school which is not otherwise graded is grade D provided that it is fully registered.

The selection of pupils for entry into maintained schools at form five level is controlled by the Ministry of Higher Education. The selection is organised on a national basis after the Kenya Certificate Examination results of the previous year have been published. Selection is open to all candidates who have indicated their wish to take an 'A' level course and who have attained a satisfactory required standard. Numbers in each class are limited to 30 students in Science classes and 35 students in Arts classes.

It is strongly recommended that no more than three principal level subjects should be taken by any student. However, there have been a few cases where students have been allowed to study four subjects at principal level. Science students normally choose three subjects at principal level from physics, chemistry, biology and mathematics. A large number of students who study biology also take chemistry and mathematics or chemistry and physics.

The Ministry of Higher Education recommends that all practical subjects should be held in the laboratory. As much practical work as possible should be carried out with at least $\frac{2}{3}$ of the time being used in this

way. The recommended period allocation for a sciene principal level subject is 8 to 10 periods per week. It is now generally agreed that practical work greatly enhances pupils' learning (Kerr, 1963).

In science, as in any subject, the student "reaps what he is willing to sow." The information gained, the appreciation of the subject, the enjoyment of the course and the evaluation by a grade are a direct reflection of what a student has put into his study efforts. Increased understanding often leads to increased interest, and the reverse is equally true.

1.3 Problem Analysis:

Growing to understand science is a little like getting to know a person. The purpose of laboratory experience is to clarify the meaning and methods of science by doing actual practical work. This includes fostering the ability to:-

(a) manipulate appropriate apparatus and materials.

(b) observe

(c) follow instructions to carry out experiments and procedures.

(d) handle experimental data.

(e) plan investigations and experiments.

(f) build the students ability to distinguish between the kinds of questions one can approach as a scientist and those which one cannot.

(g) build in students a sense of potency and limitations of science.

(h) enhance the student's ability to function meaningfully in a science - oriented society.

(i) help lay the ground work for an intelligently critical attitude towards science in general and biological sciences in particular.

The Kenya Advanced Certificate of Education Syllabus has aimed at developing the students' powers of observation using the three fundamental techniques of biology: dissection, microscopy and simple experiments with living organisms. However, if K.A.C.E means of assessment is to reflect three aims, then the Kenya National Examination Council (K.N.E.C.) must ensure that appropriate questions or mechanisms for doing so are devised. Observation can be assessed up to a point with the use of appropriate photographs and drawings. It is obviously not possible to assess pupils' manipulative skills in a theoretical situation. Whether this is best done in a practical examination or in a more continuous fashion throughout a course is debatable. If the problems of moderating different teachers' assessments can be overcome, it is almost certainly best to assess those practical classes. The traditional 'A' level dissection may have been a test of manipulative skills, but of a limited kind and in the highly stressful conditions of examination.

At 'O' level, we must question whether these

skills are assessed even in practical examination as they are now sometimes framed. After all the examiner is only provided with the candidate's writen script and does not witness him carrying out the experiment or other practical exercises.

Assessing observational skills can only be done clearly in a practical situation but one major problem arises. Living material is so variable that it is impossible to set all pupils an examination on exactly the same material. Another difficulty is that the range of material which can be set is limited and problems of collection of specimens or their distribution from a central source loom large.

The task set to each pupil can be made identical if the observation is based on a photograph or other easily reproducible material. This is probably the most appropriate means of assessing observational skills.

Assessing the ability to follow instructions and carry out experimental producres is another set of skills which could be assessed in a practical examination. However, once again several problems arise. How do we assess the skills other than by considering the pupil's results? Knowing the variability of living materials, are the results really a reflection of whether the pupil has carried out the instructions correctly? It is impossible to standardize the apparatus or the living material.

Any assessment within a practical examination must, by its very nature be limited. If these skills are to be assessed they must really be done by standing along side the pupil and watching him at work and this is obviously not feasible in a public examination like 'A' levels. Even if it were, what criteria would be used for such an assessment?

Assessing the ability to handle, present and interpret data is probably more easily assessed in a theoretical situation than in a practical examination. In a practical examination each candidate has to deal with different data which has risen out of the investigation he has performed. This data will be subject to the inherent differences in living material and to the vagaries of the apparatus he has used. His data will also be dependent on his own abilities of manipulation and observation of certain produres. In a theoretical examination, all candidates can be provided with the same data to interpret.

Designing experiments has featured increasingly in 'A' level biology and is listed among the objectives of the course. The ability to design experiments can be assessed up to a point in an entirely theoretical way. Some of the questions on experimental design run as follows:-

(a) Design an experiment to find out if a fish swimming in water gives out heat.

(b) Design an experiment to find out whether a mouse is more or less active in the dark

than it is in the light.

These questions, however, do not ascertain the extent to which the candidate can deal with the situation in a practical way. They do not examine his flexibility of approach should his theoretical plan lead him into practical difficulties. Also these abilities can probably only be assessed - and then with difficulty - on a long term basis by teachers in day to day contact with the pupils in practical classes. Problems of the criteria for assessment then arise.

From the above discussion the researcher is of the opinion that the value of the traditional biology examination must be questioned. The organisational difficulties, the lack of comparability of material; and the fact that many of the abilities under scrutiny are not very reliably assessed suggests that an alternative is probably preferable. It is probably more reliable to restrict the abilities being assessed to those which can be examined in a theoretical way.

The K.N.E.C. lays considerable emphasis on the biology practical examination results when the final grade is awarded to a candidate: A candidate can only obtain a principal pass A, B, C, D or E if he/she passes both theory and practicals. A candidate who passes theory but fails the practical examination is automatically down graded to either a subsidiary pass level or may even fail the whole subject. Steps

must therefore be taken to ensure that all the 'A' level biology papers I, II and III test what they are intended to test and keep in line with the objectives of the subject.

1.4 Purpose Of The Study

Considering the issues discussed in the previous paragraphs and the concern for the K.N.E.C. laying such great emphasis on biology practical examination in determining the over all grade of candidates, the purpose of this study is to:-

(1) Find out the degree of correlation between biology (p 531) papers I and II for all schools, national schools, non-national schools, girls schools and boys schools in 1982.

(2) Find out the degree of correlation between biology (p531) papers I and III for all schools, national schools, non-national schools, girls' schools and boys schools in 1982.

(3) Find out the degree of correlation between biology (p531 Papers I, II and III for all schools, national schools, non-national schools, girls schools and boys schools in 1982.

(4) Repeat 1-3 (above) for 1981 biology (p 531) papers I, II, III and IV.

(5) Investigate some of the reasons and causes for the correlations obtained.

1.5 Significance Of The Study

Through this study it is hoped that some of the

deficiencies and short-comings of the K.A.C.E. 'A' level biology syllabus will be reviewed critically and this will lead to the provision of fair distribution of testable objectives in the three papers the 'A' level candidates take at the end of form six.

It is anticipated that this study will provide the biology curriculum developers with useful information which will be used in the evaluation of the 'A' level biology syllabus which has not been evaluated or revised since 1978. Through this study it is hoped that the K.N.E.C. will review the 'A' level biology grading system so that performance on the practical examination does not necessarily determine whether a candidate obtains a principal pass, a subsidiary pass or a fail. It is also anticipated that by this study the KNEC will consider continuous assessment in the award of the final grade for 'A' level biology. The teachers in the field will be provided with some kind of feedback on the subject. This information is inadequate at the moment as a result of lack of personnel at the K.N.E.C.

CHAPTER II

11.1 Literature Review

Research findings on the 1981 'A' level Chemistry at the K.N.E.C. Research Unit shows that the theory papers I and II were very poorly answered with most candidates scoring ¼ of the total mark in each paper. In contrast, most candidates were able to score about ½ of the total mark in the practical work which constitutes paper III. Paper I was a stractured paper where candidates were expected to give short answers to the questions. Contrary to the expectation of the examiners, this paper was done poorly compared with paper II. The study does not, however, show why papers I and II were poorly done. One reason for the poor performance could probably be that the questions in paper I tested specific aspects of knowledge and skills which candidates either knew or did not know, whereas in paper II, candidates were given a wide field to express themselves and display a deeper understanding of chemistry. Correlations between the three papers were as follows:-

Paper I and Paper II	:	+ 0.86
Paper I and Paper III	:	+ 0.62
Paper II and Paper III	:	+ 0.61

The high correlation between theory Papers I and II indicate that very comparable skills were being tested. The comparatively lower correlations between the theory papers and the practical paper

is expected as the latter tested practical skills (experimental and manipulative) not tested in theory papers.

Futcher, (1973), reports very low correlations between practical work in chemistry and the performance in the theoretical aspects of chemistry. Some students who perform very well in the theoretical aspects of chemical tasks may invariably have very poor manipulative skills. Thus there are some excellent practical chemists whose theoretical knowledge in chemistry may not be outstanding.

It is worth pointing out also that studies of pupils' performance by Colin Wood-Robinson (1977) on theory and practical biology examinations showed correlations which were so low as to suggest that they were not measuring the same range of abilities. Kathuri, (1980) in his analysis of twelve years examinations in practical and theory in agriculture at 'O' level from 1967-1978 in Kenya found that examinations displayed consistency in omitting some areas of the syllabus and covering others very lightly (i.e. low content validity). The study showed that there was a definite lack of relationship between the content of the examinations and the objectives set for the course. It also revealed that the practical examination papers were limited in scope and that they generally tested activities but not the actual practical skills as such. The study also showed that practical examination papers were more or less an

extension of the theory papers. Infact some of the questions on the practical papers did not require any practical skills to answer them effectively. Kathuri also found that combining theory and practical papers increased the content scores variation. This was shown by a wide range of the S.D. (2.1 - 3.4) than in the theory paper alone SD (1.96 - 2.87). He found the practical examination to have been a complement or supplement to the theory paper. This probably explained why the objectives had hardly been achieved since the examination was very limited in practical skills.

According to the objectives of 'A' level biology, the theory papers should concentrate on the cognitive aspects of learning and the practical paper should concentrate on psychomotor skills.

Murphy (1980) observed that girls tend to have a higher level of achievement at 'O' level and 'A' level in science subjects. The higher female pass rate at 'A' level has sometimes been explained by there being a smaller select group of girls who stay on at school to do 'A' levels. The study also found that the boys performed better on objective-type questions than the girls while the girls performed better on the essay-type questions than the boys. One possible explanation for this particular sex difference manifestation in academic performance is the lower emphasis on verbal ability in objective test papers, as compared with more conventional written

papers. Further research using data from large scale external examinations such as 'O' level or 'A' level may well reveal the answer to this question and indeed, to many others as well. Examinations data contain a wealth of information about the effects of sex differentiation in schooling. They also provide some suprising evidence of sex differences within examination papers themselves.

Every primary and secondary school in Kenya sets its own internal examinations for each class at the end of the year. The results of these internal examinations are used for promoting students from one class to the next. At the end of standard seven, form four and form six, the students sit for external examinations set by the Kenya National Examination Council (K.N.E.C.). Standard seven candidates sit for Certificate of Primary Education (C.P.E.), form four candidates sit for Kenya Certificate of Examination (K.C.E.) and the form six sit for Kenya Advanced Certificate of Examination (K.A.C.E.)

The adherence to the system of external examinations for schools is largely due to some factors listed by Warwick et al 1972:-

(a) "External examinations ensure minimum level of competence in examining, marking and scaling procedures; many teachers are unable to set tests which are as comprehensive and reliable. Fewer still are able to relate their pupils' marks with a comparable degree of accuracy to

to those of pupils in other classes and schools."

(b) "External examinations set nationally uniform standards against which all candidates can be properly measured ..... pupils are measured by the same yard stick. The presence of such a national standard helps prevent the growth of a hierarchy of universities, rated according to the quality of their students."

(c) "External examinations provide independent court of appeal in cases where there is doubt or debate about a pupil's ability. They also provide support for school principals and staff in the face of adverse criticism from parents who disagree with the assessments given."

The implications of the above statement about external examinations are that teachers, pupils, parents and employers have faith in external examination grades because they are in theory uniformly standardized. In 'A' level examinations, the standardized criterion is the "population" norm (Lodiaga 1980). As to whether standards based on population norms change when there are large changes in the numbers of the population is still an untested hypothesis.

11.2 Methodology:

(i) Sample

The data for the research study was the 'A' level biology (p 531) theory and

practical results for 1981 and 1982 in 69 schools. Questionnaires were sent to 'A' level biology teachers in 40 sample schools. The purpose of the questionnaire was to help the researcher to explain some of the reasons and causes of the type of correlations obtained.

The actual number of schools for the study included 16 national schools and 43 non-national schools. Whereas the national schools consisted of 9 boys' and 7 girls' schools, the non-national schools consisted of 25 boys' and 18 girls' schools.

The technique applied in order to decide on the number of non-national girls and boys' schools to be included in each group was that of proportionate stratified sampling in which the four strata mentioned above were considered. The total number of schools in each province was taken into account while fixing the proportions. All national schools in the country teaching biology up to 'A' level were included in the sample.

A total of 69 schools was finally selected from the population. The sample represented about 55 % of the 'A' level schools in the country which teach biology up to form six. The distribution

of the schools is summarized in table I below:-

Table I The Sample

School Category	Girls	Boys	Total
National School	7	9	16
Non-national school	18	25	43
Total	25	34	69

This rigid grouping pattern was inbuilt in the selection of the sample to ensure that each school category was represented.

In the case of teachers, it was decided to include only a limited number of teachers who teach biology up to 'A' level in the four categories of schools. A total of 40 questionnaires were sent to teachers in the sample schools by post. Having identified the schools, the means of raw marks for each school for all the 'A' level biology examination papers (p 531) for 1981 and 1982 were obtained from the Kenya National Examination Council. All scores for candidates from each sample school were used.

(ii) Research Instruments and data collection

The mean of the raw marks for each school category was obtained from the Kenya National Examination Council (KNEC). By means of a computer, the degree of correlations between biology paper (p531) I and 2, 1 and 3, 1 and 4, 2 and 4, 3 and 4 were computed for 1981 results for the five categories of schools.

In 1982, the KNEC had reduced the number of biology papers from 4 to 3 by combining the original papers 1 and 2 to form paper 1 without altering the timing, standard or style of setting the examination. The original paper 3 then became paper 2, a theory paper, and the original paper 4 then became paper 3, a practical paper.

Also by means of a computer, the degree of correlations were computed between biology paper (p531) 1 and 2, 1 and 3 and between 2 and 3 for 1982 results for the 5 categories of schools. The details of the correlations carried out are shown in Tables III and IV.

Table III

Details of correlations carried out

1981

	Type of school	No. of Candidates	Biology Papers
(i)	National and non-national schools combined	1799	1 and 2 1 and 3 2 and 3 1 and 4 2 and 4 3 and 4
(ii)	National Schools	379	1 and 2 1 and 3 2 and 3 1 and 4 2 and 4 3 and 4
(iii)	Non-National Schools	1394	1 and 2 1 and 3 2 and 3 1 and 4 2 and 4 3 and 4
(iv)	Girls Schools only	468	1 and 2 1 and 3 2 and 3 1 and 4 2 and 4 3 and 4
(v)	Boys schools only	1305	1 and 2 1 and 3 2 and 3 1 and 4 2 and 4 3 and 4

Table IV Details of correlations carried out

1982

	Type of School	No. of Candidates	Biology Papers
(i)	National and Non-National Schools combined	1805 " "	1 and 2 1 and 3 2 and 3
(ii)	National schools	398 " "	1 and 2 1 and 3 2 and 3
(iii)	Non-national Schools	1407 " "	1 and 2 1 and 3 2 and 3
(iv)	Girls schools only	514 " "	1 and 2 1 and 3 2 and 3
(v)	Boys schools only	1291 "	1 and 2 1 and 3 2 and 3

In order to explain some of the reasons and causes for the correlations obtained, the researcher designed a descriptive type of questionnaire which was administered to a limited number of teachers who teach biology up to form six classes. The respondents were free to express themselves and fill in information which could not be obtained by ticking. The questionnaire (see appendix A) comprised of 18 questions which were classified into seven categories as shown in table V.

Table V

Details regarding the distribution of items in the questionnaire

Serial Number	Item Number	Problem Area	Number of items
1	1 - 2	school category	2
2	3 - 5 and 9	Training and teaching experience	4
3	6	class size	1
4	7 - 8 and 11	Time allocation for teaching theory and practical biology	3
5	10-12 and 15-17	'A' level biology syllabus	5
6	13-14	Teaching facilities in schools	2
7	18	'A' level biology examination	1
TOTAL			18

The questionnaire was designed to find out:-

(a) The academic qualification and teaching experience of the 'A' level biology teachers.

(b) Form five and six class size.

(c) The number of teaching periods schools allow for theory and practical work on the time table.

(d) The opinion of teachers towards the objectives, content and timing for the various topics in the 'A' level biology syllabus.

(e) The type of teaching facilities such as text books, reference books, specimens and science equipment for practical work and access to the laboratory.

(f) The opinion of teachers towards the type of questions and the standard of the examination set by the K.N.E.C. for the A level biology paper (p531).

The researcher sent the questionnaire forms to schools by post. In order to increase the chances of getting feedback, the researcher enclosed a stamped and an addressed envelope with the questionnaire at the time these were being sent to the teachers. Because of lack of time and money, the questionnaire was pre-tested using only three 'A' level biology teachers.

A series of informal discussions were made with some educational experts who are involved in marking the 'A' level biology examination papers. Also the 1981 and 1982 'A' level biology examination papers (see appendix B) were studied in order to explain some of the reasons and causes for the correlations obtained.

CHAPTER III

This chapter deals with the analysis of the correlations between theory papers and between theory and practical papers in the 'A' level biology examination results for 1981 and 1982. It also deals with the analysis of the 'A' level biology teachers' responses. The teachers who participated in the study numbered 25. The majority of the respondents, 88%, are from non-national schools (grade B) and 12% are from the national schools (grade A). The schools involved in the study numbered 69. Of these schools, 43 are non-national schools and 16 are national schools.

CORRELATIONS BETWEEN THEORY PAPERS AND BETWEEN THEORY AND PRACTICAL PAPERS

Table VI indicates that the correlation coefficients between theory papers and between theory and practical papers in all the five categories of schools are generally low. In 1981, whereas the correlations between theory papers ranged from 0.26 to 0.49 those between theory and practical papers ranged from 0.21 to 0.39. In 1982 whereas the correlations between theory papers ranged from 0.34 to 0.43 those between theory and practical ranged from 0.34 to 0.43 those between theory and practical ranged from 0.26 to 0.44.

CORRELATION COEFFICIENTS FOR THE 1981 AND 1982 'A' LEVEL THEORY AND PRACTICAL BIOLOGY

Table VI

SCHOOL CATEGORIES	1981 PAPERS						1982 PAPERS		
	1 and 2	1 and 3	2 and 3	1 and 4	2 and 4	3 and 4	1 and 2	1 and 3	2 and 3
National and non-national schools combined	0.39	0.28	0.41	0.22	0.31	0.26	0.41	0.41	0.32
National schools	0.35	0.28	0.44	0.26	0.39	0.33	0.34	0.36	0.27
Non-national schools	0.39	0.28	0.40	0.21	0.29	0.24	0.40	0.39	0.30
Girls schools	0.44	0.35	0.49	0.26	0.32	0.34	0.38	0.44	0.26
Boys schools	0.39	0.26	0.39	0.21	0.31	0.24	0.43	0.40	0.34

1981

NOTE: Paper 1: consisted of 30 items of multiple choice questions.
Paper 2: consisted of compulsory structured questions.
Paper 3: consisted of essay type questions.
Paper 4: a practical examination

1982

NOTE: Paper 1: consisted of 26 items of multiple choice questions together with short objective questions in section A.
Section B consisted of compulsory structured questions.
Paper 2: consisted of essay type questions.
Paper 3: a practical examination.

All the correlation coefficients between theory papers and between theory and practical papers were therefore found to be low in all the five categories of schools for 1981 and 1982. These low correlations are an indication that each of the 'A' level biology examination paper was testing different skills and abilities.

A look at the paper mean scores in all categories of schools for 1981 in table VII shows that the scores in all the papers were generally low. However, the table also shows that the candidates scored highest in paper I which consisted of 30 items of multiple choice questions. In this paper, all the schools scored more than 50% of the total mark. The lowest performance was in paper 2 which consisted of compulsory structured questions with several sub-parts.

In this paper no school scored above 40%. Paper 3 which consisted of essay type questions was poorly done with all schools scoring below 48%. The average score for paper 4, a practical paper, was also poorly done with no school scoring above 46%.

The 'A' level biology syllabus stresses the importance of integrating theory and practical work for effective understanding of the underlying principles in the subject. The K.N.E.C. examines any theory and the practical papers. The questions set in these papers are intended to achieve the objectives of the course as stated in chapter I of this study. Hence the examination tasks in 'A' level biology theory and practical papers are testing the same skills/ abilities but differently. Whereas the theory papers main emphasis is on the cognitive skills, that of the practical examination is on manipulative skills which are based on the cognitive skills. These cognitive and manipulative skills/abilities are stated in the objectives of the 'A' level biology course.

Therefore the correlation coefficients between the theory

papers were expected to be higher than what this study shows. Also the correlations between theory and the practical papers were expected to be slightly lower than the correlations between the theory papers but much higher than what this study shows.

Table VII

SUMMARY TABLES FOR THE PAPER MEANS IN THE DIFFERENT CATEGORIES OF SCHOOLS IN 1981 AND 1982

	1981 PAPERS					1982 PAPERS		
	1	2	3	4		1	2	3
National and non-national schools combined	16.27 (30)	28.09 (70)	46.10 (100)	44.95 (100)		47.78 (100)	44.91 (100)	42.62 (100)
National schools	17.17 (30)	30.47 (70)	47.06 (100)	45.59 (100)		51.71 (100)	48.28 (100)	45.86 (100)
Non-national schools	16.02 (30)	27.44 (70)	45.84 (100)	44.98 (100)		46.67 (100)	43.96 (100)	41.71 (100)
Girls schools	16.31 (30)	28.30 (70)	45.66 (100)	45.15 (100)		47.95 (100)	44.70 (100)	42.94 (100)
Boys schools	16.15 (30)	27.49 (70)	47.32 (100)	44.40 (100)		47.35 (100)	45.46 (100)	41.83 (100)
National means	16.03 (30)	27.66 (70)	45.41 (100)	44.30 (100)		47.33 (100)	44.49 (100)	42.20 (100)

NOTE: The figures in brackets indicate the maximum score for each paper.

Table VII also shows that in 1982 the scores in all the three papers were as low as those in 1981. With regard to theory papers, the 1982 performance for all the categories of schools was better in paper 1 than in paper 2. Paper I consisted of 26 items of multiple choice questions together with short answer objective questions in section A. Section B of paper 1 consisted of 8 long structural questions.

Whereas the highest average mean score for paper 1 was 51.71, that of paper 2 was 48.28. Paper 3, a practical paper, was done poorest with an average mean score of 45.86.

It is worthwhile pointing out here that the highest average mean scores in all the three papers were achieved by the national schools. This was expected because the national schools are better equipped and have more better qualified teachers than the non-national schools.

With regard to the degree of relationship of the skills and abilities being tested between the theory papers and between the theory and the practical paper, table VIII shows their common variances.

Table VIII

COMMON VARIANCE IN THEORY AND PRACTICAL 'A' LEVEL BIOLOGY PAPERS FOR 1981 AND 1982

CATEGORIES OF SCHOOLS	1981 PAPERS						1982 PAPERS		
	1 and 2	1 and 3	2 and 3	1 and 4	2 and 4	3 and 4	1 and 2	1 and 3	2 and 3
National and non-national schools combined	15.2	7.8	16.8	4.8	9.6	6.8	16.8	16.8	10.2
National schools	12.3	7.8	19.4	6.8	15.2	9.9	11.6	13.0	7.3
Non-national schools	15.2	7.8	16.0	5.4	8.4	5.8	16.0	15.2	9.0
Girls schools	19.4	12.3	24.0	6.8	10.2	11.4	14.4	19.4	6.8
Boys schools	15.2	6.8	15.2	5.4	9.6	5.8	18.5	16.0	11.4

The table indicates that all the common variancies are generally low for all papers in all schools. In 1981, whereas the common variance between theory and practical papers ranged from 4.8% to 15.2%, in 1982 they ranged from 6.8% to 19.4%. In 1981 whereas the common variance between theory papers ranged from 6.8% to 24%, in 1982 they ranged from 11.6% to 18.5%. It is noticeable from the table that in 1981 the common variances between theory and practical papers were fairly lower than between the theory papers. However, in 1982, there was no district difference in the common variance between the theory papers and between theory and practical papers.

The low correlation coefficients and the low common variances are an indication that the skills and abilities for which the 'A' level biology examination papers for 1981 and 1982 were testing had very little in common.

However, since this is a relationship study aimed primarily at gaining a better understanding of the relationship between complex skills and abilities being assessed in theory and practical examination papers of the K.A.C.E., such low correlation coefficients are as meaningful as high coefficients.

CORRELATION COEFFICIENTS IN NATIONAL AND NON-NATIONAL SCHOOLS IN 1981 AND 1982

Table VI also shows the correlation coefficients between theory papers (1 and 3, 1 and 3, 2 and 3) in 1981 are almost the same in both the national and non-national schools. Whereas the correlations for these papers in national schools were found to be 0.35, 0.28 and 0.44 those in the non-national schools were 0.39, 0.28 and 0.44 respectively. However, correlations between theory papers and practical papers (1 and 4, 2 and 4, 3 and 4) are slightly higher in the national schools than in the non-national schools. Whereas the

the corelations for these combination of papers were found to be 0.26, 0.39 and 0.33 in national schools, those of the non-national schools were 0.21, 0.29 and 0.24 respectively.

The table also shows that the correlation between the theory papers (1 and 2) is slightly higher in non-national schools than in the national schools in 1982. Whereas the correlation between these papers was found to be 0.34 in national schools, in the non-national schools it was 0.40. Corelations between theory and practical papers (1 and 3, 2 and 3) in 1982 were also found to be slightly higher in the non national schools than in the national schools. Whereas the correlations for the theory and practical papers (1 and 2, 2 and 3) for national schools were found to be 0.36 and 0.27, those in the non-national schools were 0.39 and 0.30 respectively.

With respect to the paper means of the raw score for 1981 and 1982 as summarized in table VII, the national schools had the highest average mean scores in all the theory and practical papers for 1982. In 1981 also the national schools had the highest average mean scores in all papers except for paper 3, a theory paper,where the boys schools scored highest. Whereas the boys' schools had an average score of 47.32 in paper 3, the national schools had 47.06.

Inspite of the high average scores in the national schools on theory and practical papers in 1981 and 1982 as shown in table VI all correlations are quite low. In 1982, the correlation between papers 1 and 2 was 0.34 and between paper 1 and 3, the correlation was 0.36 for the national schools. These were the lowest correlations among the five categories of schools in this study. One possible explanation for this could be as a result of the low variance in the abilities of the candidates in national schools.

Normally only the candidates with the top grades in the Kenya Certificate of Education (K.C.E.) stand a chance to be selected for the national schools. The non-national schools usually carry out selection of their students to form five only after the national schools have selected the top candidates from all the the provinces in the country. Hence the non-national schools have more students of mixed academic abilities than the national schools. Consequently the non-national schools have a relatively higher variability in their academic abilities as compared with the national schools.

National schools are expected to perform better than the non-national schools because they belong to grade A schools which are better equipped than other schools. They also have more better qualified staff than other schools. The non-national schools, on the other hand, are categorized as grade B schools which fall short of high standards enjoyed by the national schools.

CORRELATION COEFFICIENTS IN GIRLS AND BOYS SCHOOLS

Table VI shows that the correlation coefficients between the theory papers (1 and 2, 1 and 3 2 and 3) in 1981 were slightly higher in the girls schools than in the boys schools. The correlations in these papers were 0.44, 0.35 and 0.49 in the girls schools as compared to 0.39, 0.26 and 0.39 in the boys schools respectively.

The table also shows that in that same year the correlation coefficients between theory and practical papers (1 and 4, 2 and 4, 3 and 4) were slightly higher in the girls schools than in the boys schools. Whereas the correlations between these papers in the girls schools were 0.26, 0.32 and 0.34, those in the boys schools were 0.21, 0.31 and 0.24 respectively.

The table does not indicate a similar general pattern of

correlations between girls schools and boys schools in 1982. With regard to theory papers (1 and 2), there is a higher correlation of 0.43 in the boys schools as compared with a correlation of 0.38 in the girls schools. The correlations between the theory papers and the practical paper (1 and 3, 2 and 3) show the correlation between papers 1 and 3 in girls schools to be higher than in the boys schools while the correlation between papers 2 and 3 is higher in the boys schools than in the girls schools.

The raw means of marks shown in table VII indicates the performance of the girls and boys schools in all the theory and practical papers in 1981 and 1982 are almost at par. Hence there is no sex difference in performance between the girls schools and the boys schools.

CORRELATION COEFFICIENTS IN NATIONAL AND NON-NATIONAL SCHOOLS COMBINED TOGETHER

Table VI shows that by combining national and non-national schools, the correlation coefficients between the theory papers (1 and 2, 1 and 3, 2 and 3) in 1981 were 0.39, 0.28 and 0.41 respectively. Correlations between the theory papers and the practical paper (1 and 4, 2 and 4, 3 and 4) in 1981 were 0.22, 0.31 and 0.26 respectively. Hence the correlations between the theory papers were slightly higher than those berween theory and practical papers.

In 1982 whereas the correlation between theory papers (1 and 2) was 0.41, the correlations between theory and practical papers (1 and 3, 2 and 3) were 0.41 and 0.32 respectively. Hence there was not much difference in correlations between the theory papers and between theory and practical papers. The correlation coefficient obtained by combining the two categories of schools in 1981 are higher than those in the non-national schools but lower than those in the

national schools. In 1982 however, by combining the two categories of schools the correlation coefficients obtained between the theory papers and between theory and practical papers were higher than either the national or the non-national schools.

A look at the table of means of the raw scores, table VII, shows that in 1981 the average means of the two combined categories of schools, all the theory and practical paper average means are lower than the national means. They are also lower than the average means in the national schools but are slightly higher than the average means obtained in the non-national schools. In 1982 the table shows that the average means in the two categories of schools combined, all the theory and the practical paper average means are all lower than the means of the national schools but are almost at par with the average means of the non-national schools.

A SURVEY OF SOME OF THE FACTORS WHICH AFFECT CORRELATIONS 'A' LEVEL BIOLOGY EXAMINATION PAPERS

There are a number of factors which contribute to the low correlations obtained in this study. In order to try and explain some of them, the researcher despatched a descriptive questionnaire (see appendix) to teachers who teach 'A' level classes. It was observed that all the respondents in addition to teaching the 'A' level classes, were also heads of the biology departments in their respective schools. Analysis of the data from the questionnaire revealed a number of problems facing teachers and the 'A' level biology students. These problems in tern affect the performance of the candidates in the K.A.C.E.

With regard to teaching experience, table IX shows that the majority of the teachers, 52%, have less than 5 years of teaching experience while 28% of the teachers have teaching experience of

between 6 - 10 years.

Table IX

'A' LEVEL BIOLOGY TEACHERS' TEACHING EXPERIENCE

Q4

Number of years taught	Number of teachers	%
0 - 5	13	52
6 - 10	7	28
11 - 15	3	12
16 - 20	2	8
Over 20	0	0
TOTAL	25	100

A few teachers, however, have a fairly long teaching experience of over 10 years. In this category, 12% have the experience of 11 - 15 years and 8% have the experience of 16 - 20 years. There was no record of a teacher who had served for more than 20 years. Hence the majority of the teachers handling 'A' level classes are fairly young in the field.

Table X

THE NUMBER OF TEACHERS WHO HAVE HAD AN INSERVICE COURSE BETWEEN 1978 - 1983

Q9

	Number of Teachers	%
No	22	88
Yes	3	12
TOTAL	25	100

Table X show that the majority of the 'A' level biology teachers, 88%, have not undergone any inservice training on the 'A' level biology syllabus which has been in use in schools since 1978. Only 12% have attended an inservice training on the 'A' level biology syllabus. Hence the 'A' level biology syllabus is being taught by a majority of teachers who have not been trained to teach the various skills which are outlined in the objectives of the syllabus.

Table XI

THE NUMBER OF GRADUATE TEACHERS IN SCHOOLS TEACHING BIOLOGY UP TO FORM SIX LEVEL

Q2

Number of graduates	Number of schools	%
One	7	28
Two	18	72
TOTAL	25	100

Table XI shows that whereas the majority of the schools, 72%, have two graduate teachers for the 'A' level biology classes, 28% have only one graduate teacher.

Table XII

'A' LEVEL BIOLOGY CLASS SIZE

Q6

Number of Students	Number of schools	%
less than 10	3	12
10 - 20	4	16
21 - 30	10	40
31 - 40	3	12
More than 40	5	20
TOTAL	25	100

With regard to the number of students in class, table XII shows that the majority of the schools, 40%, have between 20 - 30 students per class. This category includes both national and non-national schools which responded to the questionnaire whereas 16% the schools have between 10 - 20 students in a class, 20% reported large numbers of over 40 students. Schools with less than 10 students in a class were only 12% and those with large numbers of between 30 - 40 were also only 12%.

Table XIII

COVERAGE OF THE 'A' LEVEL SYLLABUS WITHIN THE TIME SUGGESTED IN THE TEACHER'S GUIDE

Q10

	Number of schools	%
YES	0	0
NO	25	100
TOTAL	25	100

Table XIII shows that none of the schools is able to cover the 'A' level biology syllabus within the time suggested in the Teacher's Guide. Hence the 'A' level candidate does not have time to master the syllabus before he sits for the K.A.C.E.

Table XIV

THE NUMBER OF PERIODS PER WEEK FOR TEACHING THEORY

Q7

Number of periods	Number of schools	%
Less than six	0	0
Six	22	88
More than six	3	12
TOTAL	25	100

Table XIV shows that the majority of the schools, 88%, assign six periods per week on the school time table for teaching

theory. Only 12% of the schools assign more than six periods per week for theory.

Table XV

THE NUMBER OF PERIODS PER WEEK FOR TEACHING PRACTICAL WORK

Q8

Number of periods	Number of schools	%
Less than three	0	0
three	25	100
More than three	0	0
TOTAL	25	100

Table XV shows that all schools assign three periods per week for practical work in biology. It is also evident from table XVI below that all practical work is carried out in the laboratory.

Table XVI

THE NUMBER OF SCHOOLS WHICH TEACH PRACTICAL BIOLOGY IN THE LABORATORY

Q

Teaching biology in the laboratory	Number of schools	%
Yes	25	100
No	0	0
TOTAL	25	100%

However, a school may be fairly well equipped and be able to carry out all the practicals in the laboratory and yet fail to learn the necessary manipulative skills the 'A' level biology

syllabus demands from the student.

Table XVII

THE USE OF MICROSCOPES IN PRACTICAL CLASSES

Q11

	Number of schools	%
One microscope per student	7	28
One microscope shared between two students	16	64
One microscope shared by three or more students	2	8
TOTAL	25	100

Sharing microscopes in practical classes is a common feature in the majority of the schools. Table XVII shows that 64% of the schools have one microscope shared between two students. 28% of the schools can afford to provide each student with a microscope. However, 8% of the schools have one microscope shared among three or more students. This is normally the case in schools where classes are large.

If students have to share microscopes, it means that the teacher must have some other work ready for those students who are still waiting to use the microscope. Under such circumstances practical work preparation becomes very demanding on the teacher. The teacher may eventually not be able to pay much attention to individual student's problems during class.

Table XVIII

SOME OF THE PROBLEMS TEACHERS EXPERIENCE IN TEACHING BIOLOGY PRACTICALS

Q15(a)

Nature of the problem	N=25 frequency
Lack of finance for purchasing equipment and speciments	18
Spend a lot of time looking for specimens	10
Classes are too large	16
Lack of prepared slides	9
Lack of fresh specimens for dissection	6
Inadequate space for storage	5
Lack of supplementary information in the syllabus	4
Lack of properly trained laboratory assistant	2

With regard to practical biology, teachers experience a number of problems. Some of the problems are shown in table XVIII. From the table, it seems as though the biggest problems are those concerned with lack of finance for purchasing equipment and specimens. The problems of large classes, lack of fresh specimens, supplementary information, prepared slides and trained laboratory assistants are some of the problems expressed by the teachers.

With the problem of a wide syllabus to cover within a fairly short time, teachers find it difficult to take time off to go looking

for specimens. Some of the specimens recommended in the syllabus are not easy to find and so teachers find themselves having to travel for long distances in search of specimens.

Table IXX

Some of the ways teachers overcome the problems in practical work

Q. 15 (b)

Nature of the solution	N=25 frequencey
Use of preserved specimens	15
Keep a few animals in school for demonstration	5
Encourage students to provide their own specimens	10
Buy minimum numbers and quantities	17

Table IXX shows some of the ways teachers manage to overcome problems in the teaching of practical work. It seems as though many teachers keep down costs by cutting down on quantities of material used for teaching. In some cases teachers use preserved specimens for dissection instead of fresh ones. They also encourage students to provide their own specimens. Others keep a few animals in the school for demonstration purposes.

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Table XX

Topics which teachers find difficult to teach their students

Q 16(a)

TOPIC	N=25 frequency
Ecology	16
Genetics	15
Evolution	11
Nervous system	4
Behaviour	3
Classification of living things	2
Locomotion	3

It is not just the students who find some areas of the syllabus difficult to grasp. Table XX shows that quite a number of topics pose a problem to the teachers also. Ecology, genetics and evolution seem to be the more difficult topics for some teachers to put across to their students. Other areas of difficulty include the nervous system, behaviour in animals, classification or organisation of living things and locomotion.

TABLE XXI

Topics which teachers find difficult to cover within the suggested time

Q. 10 (a)

Topic	N=25 frequency
Genetics	16
Ecology	17
Classification/organisation of living things	10
Evolution	8
Behaviour	5
Nervous system	4

With regard to the topics which require more time to cover than what has been suggested in the 'A' level biology Teacher's Guide, table XXI shows that ecology and genetics require much more time than is allocated to them. The other topics which also require more time to cover are organisation of living things, evolution, behaviour and the nervous system. It seems therefore that those topics which teachers find difficult to put across to their students are the same ones which require more time for teaching.

Table XXII

Suggested changes to be made to facilitate teaching the difficult topics.

Q. 14(b)

Suggestion	N=25 frequency
Syllabus to specify the type of projects expected for ecology.	15
Syllabus to recommend books for teaching ecology with a local bias	5
More time to be given to ecology and genetics in the syllabus	16
Separate genetics from ecology	5
Diversify genetics practicals	4
More time and depth to be given to organisation of living things	8
Ecology to be simplified	5

Table XXII shows some of the suggestions teachers put forward to facilitate teaching the more difficult topics

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in the syllabus. With regard to ecology, teachers would like the syllabus to specify the type of projects to be taught to the students. They also suggest that the authorities should recommend suitable books for ecology with local examples and that ecology should be simplified for the teacher more than it is presented in the current syllabus. Some teachers would like genetics to be taught separately from ecology as is the case with the present syllabus. Others feel that more time should be assigned to genetics and that practicals in this area should be diversified more. In the current syllabus, practicals in genetics are confined to reproduction in plants and animals only. Some teachers would like more time and depth given to organisation of living things.

Table XXIII

Q 14(a)

Textbooks used for teaching biology theory.

Title and Author	Number of schools
Biology: A functional Approach by MB.V. Roberts	25
Ecological biology Vol I and II by Ewer and Hall	10
Plant and Animal Biology Vol I and II by Vines and Rees	8
School Science Biology Manuals (ssp) by National Biology Panel, Kenya	0

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Table XXIII

14 (b)

Textbooks used for teaching biology practicals

Title and Author	Number of schools	%
Students Manual by M.B.V. Roberts	25	100
Dissection Guides by Roberts	12	48
Experimental Biology by Kerby and Clark	4	16
Experimental Biology Manual by Creedy & Brown	4	16
Histology Atlas by Bracegirdle	5	20

The National Biology Panel in Kenya has recommended the textbooks listed in table XXIII (a) for theory. Those listed in table XXIII(b) are the recommended textbooks for practical biology. Tables XXIII (a) and (b) show that not all Schools have bought the books for their students. However, the tables show that all schools have issued their students with Biology: A functional Approach by M.B.V. Roberts for theory and the Students Manual by the same author for practical work. For ecology, which is a fairly wide and difficult topic to teach, only 40% of the schools have issued their students with Ecological Biology Vol I and II by Ewer and Hall. Dissection work takes a fairly large proportion of the time assisgned to practical work and yet only 48% of the schools have issued their students with Dissection Guides by Rowett. It is important to note that not a single school has issued the students with school

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Science Biology Manuals (SSP) by the National Biology Panel, the body which develops and designs biology syllabuses in the country.

Table XXIV

Complaints by teachers about the content, objectives and the timing of the 'A' level biology syllabus

Complaints	N=25 frequency
Content:	
The syllabus is too wide	25
The content is too theoretical	11
Practical projects in ecology not specified	18
Some topics to be combined	6
Minor topics to be omitted	6
Too much emphasis laid on mechanisms rather than on adaptation	7
The extend to which some topics are to be taught not clear in the syllabus	13
The timing for theory does not correspond to the timing for the relevant practical work	6
Topics in the syllabus should be arranged like those in G.C.E.	1
Content appropriate	5

Objectives

	N=25 frequency
Out of step with the K.A.C.E. Objectives	10
Place too much emphasis on higher levels of learning	6
Most of them are short term	5
Appropriate	1
No Comment	3

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(iii) Timing

	N=25 frequency
Inadequate	25
Adequate	0

(i) Content: Some of the complaints about the 'A' level biology syllabus are shown in table XXIV (i), (ii) and (iii). With regard to content, it is quite clear that most of the teachers find the syllabus too wide to cover within five school terms. Other complaints are centered on failure on the part of the syllabus to be specific in areas like ecology and classification of living organisms. Some teachers feel that the time for theory should correspond to the relevant practical work. However, there were five cases where teachers were happy with the content and one case where a teacher would like the topics to be re-arranged in the same order as those in the General Certificate of Education (G.C.E), London.

Objectives

In 10 out of 25 cases, teachers said that the objectives for 'A' level biology syllabus were out of step with those of the K.A.C.E In 6 out of 25 cases, teachers complained that some of the objectives placed too much emphasis on the higher levels of learning. A few teachers,

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however, felt that quite a large number of the objectives were short term. Some teachers did not make any comments on the objectives.

(iii) Timing Table XXIV (iii) shows that all teachers felt that the time allocated to cover the syllabus was inadequate.

Table XXV

Q 18 The teachers opinion of the 'Kenya Advanced Certificate of Education biology papers

Opinion	N=25 frequency
Paper 1 does not test the understanding of the subject.	10
Paper 2 questions not related to the syllabus	15
Paper 2 should have more essays	12
Appropriate	5
Questions generally below 'A' level standard	2
Questions generally above 'A' level students	10*
Tendency to repeat some questions	5
Inadequate information given in the practical instructions to teachers	3
Lack of feedback from the K.N.E.C. to Schools	8
Too little microscope work in practicals	2
Tendency to give minor topics a lot of emphasis	5
Standard of marking practicals is to high	7
Time allowed for practical examination is inadequate.	4

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Table XXV is a summary of the opinions expressed by the teachers regarding the K.A.C.E. The majority of the teachers felt that most of the questions set in paper 2 were too abstract and unrelated to the syllabus. Others felt that there should be more essay questions in paper 2 to give the candidates a choice. Some teachers also complained that paper 1 did not test the understanding of the subject. Whereas 10 out of 25 teachers felt that the K.A.C.E. questions are generally above the level of the 'A' level standard, 2 out of 25 teachers felt that the K.A.C.E. was, on the contrary, below 'A' level standard. Teachers' complaints also include the tendency of the K.N.E.C. to repeat some questions year after year; give minor topics a lot of emphasis; allocate inadequate time for practical examination, fail to give examination feedback to teachers, give inadequate information for the K.A.C.E. practical preparation instructions to teachers and failure to include microscope slide work in practical examinations inspite of the fact that schools spend a lot of time on microscope work during the course. However, 5 out of 25 teachers felt that the standard of the present K.A.C.E. is appropriate and that it should be maintained.

CHAPTER IV

SUMMARY AND CONCLUSIONS

SUMMARY:

The data for this study was the 'A' level biology (p 531) examination results for 1981 and 1982 from the KNEC. The study involved a total of 69 schools in Kenya. 43 of these schools were non-national and 16 were national. Whereas the national schools consisted of 9 boys' and 7 girls' schools, the non-national schools consisted of 25 boys and 18 girls schools. The schools were selected by proportionate stratified sampling method. The schools in the sample represented 56.6% of the 'A' level schools in the country which teach biology. In order to explain some of the type of correlations obtained, a questionnaire was sent to 40 'A' level schools which teach biology upto 'A' level. A total of 25 teachers responded to the questionnaire. A series of informal discussions were carried out with the 'A' level biology examiners.

All the means of the raw marks for each school category was obtained from the K.N.E.C. and by means of a computer, the degree of the correlation coefficients between the theory papers and between the theory and the practical papers were carried out for 1981 and 1982 K.A.C.E. results in biology (p 531)

RECOMMENDATIONS

On the bases of the findings in this study

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the following recommendations have been made:

(1) Opportunities for in-service training should be offered to practising teachers regularly so that they can keep abreast with the new educational developments. It is important that the responsibility for the transmission of the desirable skill to the learner are entrusted to a teacher who is competent and does not allow for any mistakes.

(2) The K.N.E.C. should try to send feedback of the past examinations to schools. This would help the teachers to correct the mistakes made by the students in the previous papers. It would also help the teachers and the students to gauge the depth to which various topics are to be covered. The K.N.E.C. should also take the examiners reports and the comments made by the 'A' level biology teachers regarding the K.A.C.E. biology questions more seriously than it has done in the past.

(3) Since quite a lot of detail of the 'A' level biology syllabus is actually covered at the university level, some of the topics in the syllabus should be transferred to the departments of botany and zoology at the university. The Syllabus can also be shortened by omitting

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the topics which are already covered at (K.C.E.) Kenya Centificate of Education level.

(4) If the present 'A' level biology syllabus is to continue to be examined, the number of teaching periods should be increased from 9 to 12 periods per week, as recommended by the Ministry of Higher Education. There is, however, also urgent need to revie× the syllabus in terms of time allocation, content and objectives because schools are not able to cover the syllabus within five school terms. The Ministry of Higher Education could also change the present system of selecting form five students in March. Selection could instead take place early in January so that the whole of first term is utilized for teaching. Early selection would therefore increase the time for teaching from five to six terms. Schools would then be able to cover most of the syllabus and therefore the students would be prepared to answer most of the questions in the K.A.C.E

(5) There is need to carry out item analysis of the K.A.C.E. (p 531) paperr to find out whether the skills being assessed are in line with the 'A' level biology syllabus' objectives.

(6) Since biology is a practical subject, the Ministry of Higher Education should not encourage increase in class size to the extend that teachers find it impossible to attend to individual students during practicals. There is, at the moment, the tendency to increase the size of the class without also increasing essential facilities such as science equipment, storage facilities and books.

(7) The K.N.E.C. should avoid setting practical examinations which favour the well established schools in the country. For example the 1982 Paper 3 practical preparations seemed to have been based on facilities in well established schools. The preparations for the question on photosynthesis were too demanding for the majority of the non-national schools.

(8) As many 'A' level biology teachers as possible should be invited to participate in marking 'A' level biology examination papers because these teachers are more familiar with the form six students' abilities and level of understanding than the university lecturers. These teachers are also much more familiar with the environment and the facilities the 'A' level candidate has been prepared for the K.A.C.E. examination.

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The majority of the examiners for the 'A' level biology are university lecturers. Most of these lecturers have neither the training nor the experience of teaching at the secondary school level. They therefore tend to expect a standard of performance which is far beyond the 'A' level candidate.

(9) The K.N.E.C. should utilize the untapped talents of teachers who have long experience in teaching 'A' level biology, the inspectors of the subject and the curriculum developers when it comes to setting and moderating the K.A.C.E. biology papers - intead of relying so heavily on the university staff. At the moment some of the questions set in the K.A.C.E. are unnecessarily too difficult for the candidates and even for some of the 'A' level biology teachers. Some questions also seem to have no specific answers.

Hence the understanding level of a form six candidate should be taken into consideration when the examination papers are being set, moderated and marked.

(10) The aims of the 'A' level biology syllabus are broad and seem to be more concerned with teaching than with assessment. The aims

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therefore need to be translated into examinable behavioural objectives, out of which will emerge feasible examination objectives which can be related to the examination tasks. The K.N.E.C., like many other external examining bodies does not have a specification of a set of criterial for judging the quality of the students' work and assessments are apparently left to the discretion of the chief examiners in the subjects. There is, therefore, need for the K.N.E.C. to develop a grading scheme as a check on the performance levels of candidates.

(11) Quite a large number of reference books recommended in the 'A' level Teachers' Guide are not available on the market. Therefore efforts should be made to give teachers guidance on alternative reference books which they can find on the market.

(12) Continuous assessment of the students practical work should form an integral part of the final grade a candidate is awarded in K.A.C.E.

(13) Performance in practicals should not necessarily determine the final grade to be awarded to a candidate. This is because the assessment

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of the 'A' level biology practicals is limited in many ways.

CONCLUSION

The correlation coefficients between the theory papers and between theory and the practical papers were found to be very low in all the categories of schools in 1981 and 1982. Whereas the correlation between the theory papers in the two years ranged from 0.26 to 0.49, those between theory and practical papers ranged from 0.21 to 0.34. The average scores in all the papers were also found to be low in all categories of schools including the national schools whose performance was expected to be much higher than what this study shows. The highest average score recorded was 45.86. In 1981 the candidates scored highest in paper 1 which consisted of 30 items of multiple choice questions. The lowest performance was in paper 2 which consisted of compulsory structured questions with several sub-parts. In 1982, the performance for all the categories of schools was also highest in paper 1 which consisted of 20 items of multiple choice questions together with short answer objective questions in section A, Section B consisted of compulsory structured questions set on the same format as paper 2 of 1981.

The national schools had the highest scores in almost all the the papers in 1981 and 1982. This was

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expected because the national schools enjoy more superior facilities than the non-national schools. The study also shows that there was very little difference between the average scores in theory and practical papers in the girls schools and the boys schools.

DISCUSSION

With regard to factors which contribute to the low correlations between the biology papers and the poor performance in the 'A' level biology examination, one of the major factors has to do with lack of coverage of the 'A' level biology syllabus. Table XXVI shows some of the ways teachers use to try and catch up with time.

Table XXVI

some of the ways in which teachers manage to cover the syllabus:-

Q. 10(c)

Suggestion	N=25 frequency
Extra classes taught after school or on Saturdays/prep/holidays	17
Use of practicallessons for theory	12
Shorter content to brief points	6
Assigments given on easy topics and only deal with difficult topics in c Class	18
Omit some topics altogether	4
Stress only the important points likely to come in the examination	5

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Since the number of periods allocated on the school time table are inadequate for covering the biology syllabus, teachers have devised different ways of ensuring that they cover most of the topics before their students sit for the Kenya Advance Certificate of Education (K.A.C.E.). Quite a number of teachers try to cover the syllabus by conducting extra classes after school, on Saturdays, during school evening preparation time or during the school holidays. Some teachers resort to giving students assignments on what they consider to be easy topics and deal with the difficult ones in class. In some cases, teachers use practical lessons for teaching theory, some shorten the content to brief points only, others stress only the important points which are likely to come in the examination or omit some topics altogether. Hence teachers do not have enough time to cover the syllabus properly. It follows that when teachers are unable to prepare the candidates adequately, the candidates' ability to answer all the questions on the examination which is based on the syllabus is lowered (i.e. low content validity). The candidates sit for the examination before they acquire the necessary competence to tackle all the questions in the examination.

This results in poor perfomance which in turn has a lowering effect on the variance. Lowering of the variance in turn lowers the correlation coefficients irrespective of the variables under investigation.

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According to the K.N.E.C. objectives, the 'A' level biology theory papers are an attempt to determine the extent to which the skills and abilities outlined in the 'A' level biology syllabus have been achieved by the candidates. Whereas the theory papers assess the cognitive skills, the practical paper's main emphasis is on manipulative skills which are in a way based on the cognitive skills. The cognitive skills/abilities assessed include knowledge, comprehension, application, interpretation, analysis and evaluation.

Both the Theory and the practical papers are based on the same syllabus. It was therefore expected that the correlations between the papers would be much higher than what this study shows. It was also expected that the correlations between the theory papers would be higher than those between theory and practical papers.

The low correlations obtained in this study suggest that the theory papers were not measuring the same range of skills/abilities. This sharply contrasts with the high correlations obtained between the theory papers in the 'A' level chemistry in 1981 by the K.N.E.C. Research Unit. The high correlation obtained between the theory papers (0.81) indicated that comparable skills were being tested. The correlations obtained between theory and practical papers (1 and 3, 2 and 3) were 0.62 and 0.61 respectively. The comparatively lower correlations between theory and practical paper were expected because whereas

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the theory papers tested cognitive skills, the practicals tested experimental and manipulative skills. Similar correlations between theory papers and between theory and practical papers in chemistry were obtained by Lodiaga, 1977 on G.C.E. (General Certificate of Education) and Putcher, 1973. However, studies of pupils performance by Colin Wood-Robinson, 1977 on theory and practical biology examinations showed correlations which were so low as to suggest that the biology examination papers were not measuring the same range of abilities.

In addition to lack of coverage of the syllabus, findings of this study also show that the objectives of the 'A' level biology syllabus were out of step with those of the K.A.C.E. Hence the K.A.C.E. biology examination papers have low content validity. This partly explains why 40% of the teachers complained that the 'A' level examination was far much above the ability of form six candidates. Also 60% of the teachers complained about the compulsory essay type questions. Some of them felt that those questions were not related to the syllabus because they demanded greater depth of subject matter than what the syllabus indicated.

Kathuri, 1980 in his analysis of theory and practical examination papers in agriculture at 'O' level found that there was definite low content validity as a result of lack of relationship between the content of the examinations and the objectives set for the course. The study also revealed weaknesses in practicals similar to those sighted in the

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'A' level biology practicals.

The poor performance in the practicals for all the schools could be as a result of a number of problems involved in the assessment of the practical skills. According to the K.N.E.C., the assessment of the practical paper includes various skills such as observational and manipulative skills, ability to follow and carry out experi mental procedures. Skills and abilities of this nature are not easy to assess under examination conditions within three hours.

It is possible that some of the questions are answered poorly because of inadequate information given in the confidential practical instructions and on the question paper for example, in 1982 paper 3 question, 1 it was not possible for the teachers to say for sure whether the frogs given to the students were just anaesthetized or completely dead. On the same paper there was no emphasis that the candidates must start with answering question 1. Under the examinations pressure it was possible that candidates started with either quertion 2 or 3 and did question 1 last. Any student who did question 1 last must have dissected the frog when it was completely dead and therefore could not indicate the direction of flow of blood in the blood vessels. Therefore it is important for the K.N.E.C. to thoroughly analyse the examination papers before they are sent to schools.

The poor performance in practicals could also have

been due to other factors such as organisational difficulties especially in the schools where classes are large, the lack of comparability of the living materials and apparatus used by the candidates and also the fact that many of the abilities/skills under scrutiny may not have been very reliably assessed. The examiners of 'A' level biology practicals are only provided with the candidates' written scripts. These results may not have a true reflection of whether the candidate carried out the instructions correctly or not. The examiner does not witness the candidate carry out the practical skills. On certain occassions also neatness, correctness in spelling of words, labelling and drawing of diagrams and probably other minor factors could unfavourably influence the impression marking procedure. Hence the assessment of the candidate's manipulative skills as is practised by the K.N.E.C. is limited and so the Council should seriously consider continuous assessment throughout the course during normal practical classes if the problems of moderating different teachers' assessments can be overcome.

The study shows that all the 'A' level biology teachers are university graduates. However, although these teachers may be academically qualified, the majority, 88%, have not been inserviced on the 'A' level biology syllabus. Some of them therefore lack the competence of teaching the skills the syllabus demands. Furthermore, the teachers complain that the syllabus is too ambitious and too wide to be covered within the suggested time in the Teachers' Guide. The study also shows that a good

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number of the 'A' level teachers have very little teaching experience at form six level and so some of them lack confidence to deviate from what is suggested in the Teachers' Guide.

Because of some of the limitations teachers have, quite a good number of them find some of the topics difficult to teach their students. Failure of theK.N.E.C. to send feedback to schools also succeeds to agrevate the teachers' problems because these teachers find themselves unable to correct the mistakes made by their pupils on the previous examinations. Also with poor performance of candidates on the 'A' level biology examination papers year after year, teachers find it rather difficult to gauge the depth to which the examiner wants certain topics to be covered. Some teachers admitted that some of the questions set by the K.N.E.C. were even too difficult for them to do. Therefore if a situation like this arises, the K.N.E.C. can only expect poor performance from the 'A' level biology candidates year after year.

One way in which teachers could be helped to overcome problems associated with difficult topics such as ecology, genetics and evelolution is for the curriculum developers and the K.N.E.C. to include more detailed guidance in the 'A' level biology syllabus and the Teachers' Guide. For ecology, the syllabus should also specify the type of projects to be taught.

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With regard to the theory papers of the K.A.C.E., paper 3 (1981) and paer 2 (1982) had essay type questions for which subjective marking was the only method available. The element of choice made it necessary to treat all essay questions as comparable as far as overall skills/abilities tested each question were concerned. The response styles and cognitive preferences of some candidates could have influenced candidates' performance in these papers. Essay questions involve communication skills (expression, relevance, logic and sequencing). In general, the calibre of the 'A' level student in non-national schools falls far below that of national schools. There English is quite poor and this is already an impediment. Some candidates fail because they do not understand the language of the questions. Moreover, the quality of the candidate's work is based on written communication and so if a student cannot express himself clearly on paper, his/her performance will be affected. The essay type questions in the theory paper largely demand proficiency in effective commucation through writing. Hence a student may be well versed in theoretical biology (excellent latent content) but if the content is not effectively communicated to the examiner, then there is no evidence for it.

It seems as though the compulsory essay questions in the theory paper are causing teachers a great deal of concern. Teachers have complained that some of these essay questions demand greater depth of treatment of the subject matter than the course syllabus shows. For example

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in 1982 paper 2, the question on ecology required students to discuss how they would determine bird population in a woodland. Such a question was technical for the 'A' level candidate who largely deals with the principles of ecology to be able to provide sufficient specific information which the examiner wanted.

The compulsory essay questions also tend to be abit too ambitious and unproportionately too long for the time allocated. The K.N.E.C. should try to keep the standard high but should be careful that the high standard does not soar above the 'A' level great attention to the course objectives when the K.A.C.E. papers are being set.

The authorities dealing with preparation of the syllabus should take the trouble to revise the syllabus in terms of time allocated to various topics, the objectives of the course and the content. If steps are not taken to review the course and the examination objectives the performance in 'A' level biology will continue to be low and the correlations between the examination will also continue to be low.

Appendix A

Kenya Institute of Education

Survey of the 'A' Level biology

May 1983

1. Name of the School _____

2. School Postal Address _____

_____

_____

3. Name of the teacher in charge of the Biology Department and qualifications: Name _____

Trained graduate/non-trained graduate

4. For how many years have you taught 'A' level biology?

_____

5. (a) Name of other teachers in the biology department, their qualifications and teaching experience.

Name	Qualification	Experience
(i)	.....	.....
(ii)	.....	.....
(iii)	.....	.....
(iv)	.....	.....

6. How many students do you have in your Form 6 class this year?

(a) less than 10
(b) 10 - 20
(c) 20 - 30
(d) 30 - 40
(e) over 40

7. How many periods are used for teaching biology (practical and theory) in forms 5 and 6 per week?
.....

8. How many periods are spent on teaching only practical biology per week? .....

9. (a) Have you ever attended an inservice course in 'A' level biology? Yes or No?

(b) If answer is yes, when did you attend one?
.....

10. (a) Have you been able to cover each topic within the time suggested in the Teacher's Guide? Yes or No?

(b) If you have not been able to cover the topics within the suggested time, list the topics which you have often found impossible to complete within the suggested time .....
.....
.....
.....
.....

(c) How do you often get over the problem of inadequate time for the topics you have listed? .....
.....
.....
.....
.....
.....

11. How many of the practical periods do you find necessary to conduct in the classroom and not in the laboratory? .....

12. What problems have you encountered in preparing for the 'A' level biology 'mock" exams and the K.A.C.E.? (Please list the problems) if any.

p.t.o

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13. (a) During practical work, do you usually have a microscope to each student? Yes/No ?

(b) If the answer is No, how do you get over the problem

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14. Please list the text books you have issued to your students for biology theory & practicals.

(a) Theory biology:

Title of the text book	Author
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....

14 (b) Practicals:

Title of the text book	Author
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....

(c) Do you have access to any other reference books other than the students text books? Yes/No? If you do, please list the books you often use for reference.

Title of the book	Author
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....

15. Do you have any problems finding specimens for practicals? Please describe the nature of the problems.

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How do you get over the problems of the availability of these materials?

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16 (a) What topics in the 'A' level syllabus do you find most difficult to teach your students?
List them in order starting with the most difficult one.

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(b) What changes would you like to see made in order to facilitate the teaching of the topics you have listed?

Topics	Suggested change
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....

17 What suggestions would you like to make to improve the 'A' level biology syllabus in terms of content, time and objectives?

(a) Content

.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....

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(b) Time:

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(c) Objectives:

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18. What is your candid opinion of the type of questions and standard of the K.A.C.E. biology exam papers in relation to the syllabus and the calibre of the 'A' level students you teach?

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